

1 **WHAT IS CLAIMED IS:**

- 2 1. A passive cooling system for an auxiliary power unit
3 installation on an aircraft, comprising:
4 an auxiliary power unit housed within a nacelle of the
5 aircraft, the auxiliary power unit comprising at
6 least a compressor portion of a gas turbine engine
7 and an oil cooler contained separately within said
8 nacelle;
9 an engine exhaust opening defined in the aft portion of
10 said nacelle and communicating with said gas
11 turbine engine;
12 at least a first air inlet duct communicating with a
13 second opening defined in said nacelle and with
14 said compressor portion; and
15 said oil cooler located within a second duct
16 communicating with an opening other than the engine
17 exhaust opening of said nacelle and with said
18 engine exhaust opening, whereby exterior cooling
19 air and engine exhaust ejected through said engine
20 exhaust opening, entrain cooling air through said
21 second duct to said oil cooler, providing engine
22 oil cooling.
- 23 2. The passive cooling system as defined in claim 1,
24 wherein said second duct is bifurcated from said first
25 air inlet duct, and extends downstream from said first
26 duct portion, and a third duct portion, also formed

1 downstream of said first duct portion, communicates
2 with said compressor portion.

3 3. The passive cooling system as defined in claim 1,
4 wherein said second duct is communicating with a third
5 opening defined in said nacelle and with said engine
6 exhaust opening.

7 4. The passive cooling system as defined in claim 1,
8 wherein said compressor portion comprises a load
9 compressor and a core compressor.

10 5. The passive cooling system as defined in claim 1,
11 wherein an opening defined in one of said first duct
12 and said second duct, is in communication with the
13 exterior of said gas turbine engine within said
14 nacelle.

15 6. The passive cooling system as defined in claim 2,
16 wherein said first duct comprises an airflow splitter
17 with a leading edge upstream of the bifurcation of said
18 second duct, and said second duct empties into said
19 nacelle downstream of said oil cooler.

20 7. The passive cooling system as defined in claim 1,
21 wherein said oil cooler comprises an air to oil heat
22 exchanger.

23 8. The passive cooling system as defined in claim 1,
24 wherein said engine exhaust opening is in fluid flow
25 communication with an exhaust eductor assembly.

- 1 9. The passive cooling system as defined in claim 1,
2 wherein said nacelle is located within the tailcone of
3 the aircraft.
- 4 10. The passive cooling system as defined in claim 1,
5 wherein said nacelle has external access doors.
- 6 11. The passive cooling system as defined in claim 1,
7 wherein said second duct is integrated with a
8 compressor surge bleed duct, downstream of said oil
9 cooler.
- 10 12. The passive cooling system as defined in claim 8,
11 wherein said exhaust eductor assembly comprises a
12 dedicated opening for the exit of cooling air from said
13 nacelle.
- 14 13. The passive cooling system as defined in claim 8,
15 wherein protection for said gas turbine engine from
16 foreign object damage is provided.
- 17 14. The passive cooling system as defined in claim 13,
18 wherein said second duct is in direct communication
19 with said exhaust eductor, said oil cooler is located
20 at the junction of said second duct and said exhaust
21 eductor, and said oil cooler is oriented parallel to
22 and offset from the airflow through said second duct.
- 23 15. The passive cooling system as defined in claim 14,
24 wherein a scavenge discharge duct is in fluid flow

1 communication with said second duct and with a further
2 opening defined in said nacelle.

3 16. The passive cooling system as defined in claim 8,
4 wherein said second duct is directly communicating with
5 a third opening defined in said nacelle and with said
6 exhaust eductor assembly, said oil cooler is located at
7 the junction of said second duct and said exhaust
8 eductor assembly, and said oil cooler is oriented
9 perpendicular to the airflow through said second duct.

10 17. The passive cooling system as defined in claim 16,
11 wherein said second duct comprises a dedicated opening
12 for one of an inlet and an exit of cooling air for said
13 nacelle.

14 18. The passive cooling system as defined in claim 8,
15 wherein a further opening defined in said nacelle is in
16 communication with said exhaust eductor assembly.

17 19. The passive cooling system as defined in claim 18,
18 wherein said further opening is an air inlet to said
19 nacelle and said exhaust eductor provides an air exit
20 from said nacelle.

21 20. The passive cooling system as defined in claim 19,
22 wherein said further opening and said exhaust eductor
23 are in communication via one of a dedicated opening in
24 said exhaust eductor and a dedicated opening in said
25 second duct.

- 1 21. The passive cooling system as defined in claim 8,
2 wherein said exhaust eductor assembly is in fluid flow
3 communication with a compressor surge bleed duct.
- 4 22. The passive cooling system as defined in claim 8,
5 wherein said exhaust eductor assembly is in direct
6 fluid flow communication with said second duct.
- 7 23. The passive cooling system as defined in claim 22,
8 wherein mixing nozzles within said exhaust eductor
9 assembly integrate said cooling air from said second
10 duct with said engine exhaust.
- 11 24. The passive cooling system as defined in claim 23,
12 wherein said exhaust eductor assembly comprises an
13 axisymmetric primary nozzle located upstream of said
14 mixing nozzles.
- 15 25. The passive cooling system as defined in claim 24,
16 wherein said axisymmetric primary nozzle defines a
17 velocity of said engine exhaust, and correspondingly a
18 volume of said cooling air entrained through said
19 second duct.
- 20 26. The passive cooling system as defined in claim 24,
21 wherein said axisymmetric primary nozzle is defined by
22 an outer annular shroud and a central exhaust plug.
- 23 27. The passive cooling system as defined in claim 26,
24 wherein said central exhaust plug comprises cavities
25 therein for providing acoustic treatment.

1 28. The passive cooling system as defined in claim 27,
2 wherein said cavities attenuate low frequency sounds.

3 29. A passive cooling system for an auxiliary power unit
4 installation on an aircraft, comprising:

5 an auxiliary power unit housed within a nacelle of the
6 aircraft, the auxiliary power unit comprising at
7 least a compressor portion of a gas turbine engine
8 and an oil cooler contained separately within said
9 nacelle;

10 an engine exhaust opening defined in the aft portion of
11 said nacelle and communicating with said gas
12 turbine engine via an exhaust eductor assembly;

13 said exhaust eductor assembly being in fluid flow
14 communication with a compressor surge bleed duct;

15 at least a first air inlet duct communicating with a
16 second opening defined in said nacelle and with
17 said compressor portion; and

18 said oil cooler located within a second duct
19 communicating with an opening other than the engine
20 exhaust opening of said nacelle and with said
21 engine exhaust opening, whereby exterior cooling
22 air and engine exhaust ejected through said exhaust
23 eductor assembly, entrain cooling air through said
24 second duct to said oil cooler, providing engine
25 oil cooling.

26 30. The passive cooling system as defined in claim 29,
27 wherein said exhaust eductor assembly comprises an

1 annular axisymmetric primary nozzle upstream of a
2 plurality of radially located mixing nozzles.

3 31. The passive cooling system as defined in claim 30,
4 wherein said mixing nozzles integrate said cooling air
5 from said second duct with said engine exhaust.

6 32. The passive cooling system as defined in claim 31,
7 wherein said annular axisymmetric primary nozzle
8 defines a velocity of said engine exhaust, and
9 correspondingly a volume of said cooling air entrained
10 through said second duct.

11 33. The passive cooling system as defined in claim 32,
12 wherein said annular axisymmetric primary nozzle is
13 defined by outer annular shroud and a central exhaust
14 plug.

15 34. The passive cooling system as defined in claim 33,
16 wherein said central exhaust plug comprises internal
17 cavities adapted to provide acoustic attenuation.

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